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Book review

J. W. Hovenier, C. van der Mee, H. Domke, *Transfer of polarized light in planetary atmospheres—basic concepts and practical methods*. Springer, Berlin, 2004 (US$ 99, Hardbound: ISBN 1-4020-2855-5)

While polarization is a fundamentally inherent property of light and other electromagnetic radiation, in most books on atmospheric radiation this fact is either suppressed or mentioned only in passing. Instead, the discussion is focused on the approximate scalar version of the radiative transfer equation, quite often without stating that explicitly. Although the scalar approximation leads to significant simplifications, the errors caused by the neglect of polarization are hardly ever discussed. Furthermore, it is rarely mentioned that by neglecting polarization one voluntarily discards most of the information about the physical properties of the scattering object potentially contained in the scattered light. One should, therefore, welcome the appearance of the book by Hovenier et al., in which the treatment of radiative transfer rests on the firm ground of electromagnetic theory.

This excellent monograph describes the fundamentals of the theory of polarized light transfer in planetary atmospheres and other sparse particulate media in a systematic, clear, and concise way. Basic concepts as well as specific practical techniques are outlined, both for single and multiple scattering of electromagnetic radiation by molecules and randomly distributed particles of any size and shape.

The book begins with a summary of the single-scattering theory followed by a detailed account of the vector radiative transfer theory. Chapters 4 and 5 are devoted to a comprehensive discussion of the order-of-scattering and adding–doubling solutions of the vector radiative transfer problem for plane-parallel media. An important underlying assumption throughout most of the book is that the scattering medium is macroscopically isotropic and mirror symmetric. This implies that the constituent particles must be spherically symmetric or otherwise randomly oriented. Furthermore, each nonspherical particle must have a plane of symmetry and/or must be accompanied by a mirror counterpart. This model of a discrete scattering medium is nonetheless rather general and has a remarkably wide range of practical applications.

The book by Hovenier et al. is most notable for systematic usage of fundamental symmetry principles such as reciprocity and mirror symmetry. This helps the authors to make the vector theory of radiative transfer more transparent and easier to understand. Furthermore, it results in a significant reduction of computational burden.

The six appendices contain useful supplementary information such as a general account of properties of matrices transforming Stokes parameters of light beams and a summary of properties of generalized spherical functions. Each chapter is concluded with problems accompanied by answers or hints for solution.

Although the main emphasis is on multiple scattering of light in terrestrial and planetary atmospheres, a large part of the book is also quite relevant to studies of light scattering by particles in comets, interplanetary and interstellar environments, circumstellar dust envelopes and disks, reflection nebulae, water bodies such as oceans and lakes, and various gaseous and liquid suspensions.

The book is suitable as a textbook for advanced undergraduate as well as graduate students. It is also a must for professional scientists and engineers specializing in one of the many disciplines in which electromagnetic scattering by particles plays an important role: astrophysics, atmospheric optics, remote sensing, marine optics, optical and electrical engineering and communication, chemistry and physics of colloids, biophysics, and biomedicine.

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